1417

Issued January 8, 1912.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN 479.

Experiment Station Work, LXVII.

Compiled from the Publications of the Agricultural Experiment Stations.

SCREENING CABBAGE SEED BEDS.
SPRAYING APPLE ORCHARDS.
NEW TYPE OF SPRAY NOZZLE.
PREPARATION OF CORN FOR HOGS.
EXPERIMENTS IN BEEF PRODUCTION.
PREPARATION OF CHOICE HAMS.
FACTORS AFFECTING FAT IN CREAM.

NOVEMBER, 1911.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1912.

THE AGRICULTURAL EXPERIMENT STATIONS.

ALABAMA—
College Station: *Auburn;* J. F. Duggar.[1]
Canebrake Station: *Uniontown;* L. H. Moore.[1]
Tuskegee Station: *Tuskegee Institute;* G. W. Carver.[1]

ALASKA—*Sitka:* C. C. Georgeson.[2]

ARIZONA—*Tucson:* R. H. Forbes.[1]

ARKANSAS—*Fayetteville:* C. F. Adams.[1]

CALIFORNIA—*Berkeley:* E. J. Wickson.[1]

COLORADO—*Fort Collins:* C. P. Gillette.[1]

CONNECTICUT—
State Station: *New Haven;* E. H. Jenkins.[1]
Storrs Station: *Storrs;* L. A. Clinton.[1]

DELAWARE—*Newark:* H. Hayward.[1]

FLORIDA—*Gainesville:* P. H. Rolfs.[1]

GEORGIA—*Experiment:* Martin V. Calvin.[1]

GUAM—*Island of Guam:* J. B. Thompson.[2]

HAWAII—
Federal Station: *Honolulu;* E. V. Wilcox.[2]
Sugar Planters' Station: *Honolulu;* C. F. Eckart.[1]

IDAHO—*Moscow:* W. L. Carlyle.[1]

ILLINOIS—*Urbana:* E. Davenport.[1]

INDIANA—*La Fayette:* A. Goss.[1]

IOWA—*Ames:* C. F. Curtiss.[1]

KANSAS—*Manhattan:* E. H. Webster.[1]

KENTUCKY—*Lexington:* M. A. Scovell.[1]

LOUISIANA—
State Station: *Baton Rouge;*
Sugar Station: *Audubon Park, New Orleans;*
North La. Station: *Calhoun;*
Rice Station: *Crowley;*
} W. R. Dodson.[1]

MAINE—*Orono:* C. D. Woods.[1]

MARYLAND—*College Park:* H. J. Patterson.[1]

MASSACHUSETTS—*Amherst:* W. P. Brooks.[1]

MICHIGAN—*East Lansing:* R. S. Shaw.[1]

MINNESOTA—*University Farm, St. Paul:* A. F. Woods.[1]

MISSISSIPPI—*Agricultural College:* J. W. Fox.[1]

MISSOURI—
College Station: *Columbia;* F. B. Mumford.[1]
Fruit Station: *Mountain Grove;* Paul Evans.[1]

MONTANA—*Bozeman:* F. B. Linfield.[1]

NEBRASKA—*Lincoln:* E. A. Burnett.[1]

NEVADA—*Reno:* J. E. Stubbs.[1]

NEW HAMPSHIRE—*Durham:* J. C. Kendall.[1]

NEW JERSEY—*New Brunswick:* J. G. Lipman.[1]

NEW MEXICO—*Agricultural College:* Luther Foster.[1]

NEW YORK—
State Station: *Geneva;* W. H. Jordan.[1]
Cornell Station: *Ithaca;* L. H. Bailey.[1]

NORTH CAROLINA—
College Station: *West Raleigh;* C. B. Williams.[1]
State Station: *Raleigh;* B. W. Kilgore.[1]

NORTH DAKOTA—*Agricultural College:* J. H. Worst.[1]

OHIO—*Wooster:* C. E. Thorne.[1]

OKLAHOMA—*Stillwater:* J. A. Wilson.[1]

OREGON—*Corvallis:* J. Withycombe.[1]

PENNSYLVANIA—
State College: T. F. Hunt.[1]
State College: Institute of Animal Nutrition, H. P. Armsby.[1]

PORTO RICO—
Federal Station: *Mayaguez;* D. W. May.[2]
Sugar Planters' Station: *Rio Pedras;* J. T. Crawley.[1]

RHODE ISLAND—*Kingston:* H. J. Wheeler.[1]

SOUTH CAROLINA—*Clemson College:* J. N. Harper.[1]

SOUTH DAKOTA—*Brookings:* J. W. Wilson.[1]

TENNESSEE—*Knoxville:* H. A. Morgan.[1]

TEXAS—*College Station:* B. Youngblood.[1]

UTAH—*Logan:* E. D. Ball.[1]

VERMONT—*Burlington:* J. L. Hills.[1]

VIRGINIA—
Blacksburg: S. W. Fletcher.[1]
Norfolk: Truck Station, T. C. Johnson.[1]

WASHINGTON—*Pullman:* R. W. Thatcher.[1]

WEST VIRGINIA—*Morgantown:* J. H. Stewart.[1]

WISCONSIN—*Madison:* H. L. Russell.[1]

WYOMING—*Laramie:* H. G. Knight.[1]

[1] Director. [2] Special agent in charge.

EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

CONTENTS OF NO. LXVII.

ILLUSTRATION.

EXPERIMENT STATION WORK.[1]

SCREENING CABBAGE SEED BEDS.[2]

Root maggots (*Pegomya* spp. *et al.*) often cause serious destruction to cabbage seedlings by attacking the underground portion of the plant. A number of methods for the prevention and control of root maggots have been employed and are described in a circular of the Bureau of Entomology of the United States Department of Agriculture.[3] A serious outbreak of these pests is at the best difficult to combat. The amount of damage done varies from year to year and is most serious in northern sections, where late cabbages are grown, since the seed beds are started in the open in April or May when other food supply for the maggots is apt to be scant.

In a recent bulletin of the New York State station, Mr. W. J. Schoene describes the work of root maggots in cabbage in central New York as follows:

> The adults of the cabbage maggot appear about May 15 and oviposit about [the] plants. The eggs are found in large numbers from May 20 to June 5. On hatching, the larva attack either the stalk or the roots of the plant. The newly hatched larva is less than one-twentieth of an inch long, and the injury to the plant is at first slight and does not become important until the maggot is 8 or 10 days old. In the latitude of Geneva the maggot work becomes conspicuous about June 15, and generally the grower is not aware of the presence of the insects in injurious numbers until many of the plants are killed.
>
> The injury to the plant depends upon its size, the weather, and the number of insects feeding upon the roots. The members of the cabbage family are very thrifty and, other conditions being favorable, will outgrow considerable injury. However, if the plant is small or the maggots numerous, as is frequently the case, the root is entirely destroyed. The number of seedling plants that are spoiled for transplanting in a moderate infestation depends upon the weather. A period of dry weather and a few maggots will destroy a seed bed as quickly and completely as a bad infestation accompanied by more favorable weather conditions.

Root maggots did so much damage to seed beds around Seneca Castle, N. Y., in 1906 that the New York State station undertook some cooperative experiments in that region in the following season

[1] A progress record of experimental inquiries published without assumption of responsibility by the department for the correctness of the facts and conclusions reported by the stations.

[2] Compiled from New York State Sta. Bul. 334.

[3] U. S. Dept. Agr., Bureau of Entomology Circ. 63.

to determine the value of screening with cheesecloth as a means of protection against the maggots and to ascertain methods by which plants could be grown under frames without appreciably reducing their vitality for transplanting purposes. The results of these initial experiments, as reported in a former bulletin of the station,[1] were so successful that the number of cabbage growers in the above locality who have used cheesecloth to protect at least a portion of their plantings has increased each season. In 1910 a large proportion of the plants were started under screens. The station has thus been afforded abundant opportunity to study the details of raising plants in screened frames and to determine upon the practicability of this method of protection.

After observing practical tests with cheesecloth during a period of four years, Mr. Schoene reports that the use of cheesecloth is entirely practicable; the cost of screening in a number of operations ranging from 6 to 20 cents per thousand plants. The maggots were completely controlled, and certain grades of cheesecloth also prevented injury by the turnip flea beetle (*Phyllotreta vittata*), a less important but at times serious pest, which gnaws round holes in the young plants and is often controlled by very frequent applications of tobacco dust or by one of the arsenical sprays.

During the four years that screens have been employed for the protection of cabbage plants much has been learned regarding their use: (1) If the cheesecloth is carefully attached and the frame is tight, injuries by the maggot can be entirely prevented; (2) the work of the flea beetles may be partially or wholly avoided, depending on the grade of cloth used for the screen; and (3) the screen conserves the moisture and prevents baking of the soil between seeding time and the period when the plants are of such a size as to permit cultivation.

Before the plants are of the desired size to set in the field they are very susceptible to changes in moisture and temperature. The young cabbage plants are shallow-rooted and very tender. They do not thrive in dry or cool weather, and they are also liable to be injured by a heavy rain, lack of cultivation, and weeds. Thus the conditions of growth that surround the plant are oftentimes of more importance than is realized by the farmer, and the great difference in the growth of the plants covered by cheesecloth and those not protected is to be attributed in part to the fact that the conditions for growth under the screen are more congenial.

In most seasons screened plants grow faster and obtain the size desired earlier than plants not screened. The difference in the size of the plants screened and not screened is very apparent in early seedlings where the seed is planted during April or the first part of May. In later plantings the difference is not so marked, and now and then the plants in the open grow just as fast and make more desirable seedlings. In addition to the larger size of the plants, shade has the general effect of reducing the actual weight of dry matter stored in the plants; that is, shading makes plants more succulent. The temperature and moisture conditions produced by cheesecloth shade are well known.

[1] New York State Sta. Bul. 301.

In general the effect of screening is to reduce sunlight and air circulation and to raise the temperature both of the air and soil. Thus we have two opposing factors: One, the shade tending to decrease the rate of growth, and the other, a higher temperature and more favorable moisture conditions, having the opposite effect. * * * It is probable that the increase of the temperature and moisture is more important than the reduction in sunlight and that the screened plants will always make a faster growth except when the optimum conditions of light, temperature, and moisture obtain in the open, which rarely happens in this latitude during May and the first two weeks of June.

Various grades of cheesecloth ranging from 17 to 50 threads to the inch were used during the four years. They were all effective in preventing injury by maggots, and the only flea-beetle injury noticed was in beds under the 17-thread cloth. This grade of cloth easily stretches out of shape in tacking it to the frame, while plants grown under the closely woven 50-thread cloth have shown slight tendency to be spindling. The cloth having from 20 to 30 threads to the inch is preferred for the purpose of protecting the seedlings. Furthermore, these grades handle easily in putting them on and taking them off the frame. When grown under such screens the plants compare very favorably in stockiness with those grown in open beds, and they are not so liable to the attacks of flea beetles. Although the screened beds are more liable to mildew and other fungus diseases than the open beds, no serious outbreaks of any disease occurred during the four years.

Some growers prefer to screen their seed beds in order to get plants for early setting, since the cabbage harvested first in the fall frequently brings a better price than the main crop.

Although these experiments were conducted in central New York, the following suggestions are applicable to a much larger area, since cabbage maggots are the cause of more or less serious loss year after year throughout the northern tier of States and Canada. It should be borne in mind, however, that the time when the adult maggots appear will vary for different localities.

The seed bed should be located on a fertile, well-drained soil, where there can be no accumulation of water or washing under the frame by rains. It is also desirable to locate the bed on land known to be free from weeds and injurious insects such as wireworms and white grubs. The ground should certainly be free from the disease known as club root. The soil should be thoroughly cultivated so that it is in good physical condition at seeding time. It is customary to apply liberal amounts of high-grade commercial fertilizer. The seed should be drilled rather thickly, in rows 6 or 8 inches apart. When the early varieties of cabbage are to be grown, the seed should be planted during the first part of May or even earlier, whereas such varieties as Danish should be planted about May 15. Before the seed is drilled, the corners of the bed should be staked, so that the frame can be built and the cheesecloth applied before the plants come up. This is important as the cloth prevents the soil from baking and conserves the moisture; also, if the screening is delayed until after the plants come up, the plants are subject to injury by the flea beetle.

Six-inch boards will serve for the frame, though some growers use 8 and 10 inch boards with satisfaction. The cloth should not sag and rest on the plants. This may be prevented by stretching several lengths of wire from end to end of the bed. The wires should not be more than 4 or 5 feet apart. The wire can be supported on stakes, to which it is held by staples. It is preferable that galvanized wire and staples be used, as rusty wire wears holes in the cloth at the point of contact. All openings under the frame, due to unevenness in the soil, should be filled by banking the earth against the boards. To harden the plants so they will not wilt beyond recovery when set in the field, the cheesecloth should be removed a week or 10 days before transplanting. It is well to examine the soil about the plants at intervals of several days after they have been uncovered to ascertain if eggs are being deposited. If the eggs are numerous the plants should be transplanted as soon as possible, the earth being shaken from the roots, which will dislodge most of the eggs or young maggots. When the plants have reached a desirable size they should be transplanted, as they are liable to grow too long and spindling.

DOES IT PAY TO SPRAY APPLE ORCHARDS? [1]

Results recently reported by R. A. Emerson and others of the Nebraska station furnish a valuable illustration of the profitableness of thorough spraying as a regular orchard practice. In 1906 the experiment station, in cooperation with this department, began a series of spraying demonstrations in eastern Nebraska apple orchards. During the five years that these experiments have been continued demonstrations have been made in 22 orchards, representing 18 localities in 13 counties.

Before the work was begun it was well known that it was possible by proper spraying to control scab and codling moth, the most generally troublesome pests of apple orchards in Nebraska. There was available, however, very little definite information regarding the cost of spraying or the profits to be derived from it under our conditions. The majority of farmers made no attempt at spraying. Many of the more prominent commercial orchardists, even, were trying to produce apples without spraying, and those who were spraying more or less regularly were, with few exceptions, not sufficiently thorough in their work to get the best results. On account of the lack of knowledge of the proper means to employ in combating the common orchard pests, many orchardists had come to believe that apple growing was not a profitable business; and under the conditions prevailing in many orchards, this was a perfectly correct conclusion.

It was therefore planned from the start not merely to demonstrate the possibility of controlling apple insects and diseases but also to determine whether they could be controlled profitably. * * *

The work was done under all sorts of conditions. The trees varied in age from 10 to 28 years and averaged about 18 years. In some orchards they had been well pruned, but in more cases they had been pruned little or not at all for some years. In some cases the spraying was hindered by the closeness of the trees and in others by a secondary crop of bush fruits. In some orchards, on the other hand, the trees were conveniently spaced and the ground was free from troublesome bushes. A few orchards had almost every convenience for mixing and applying the spray materials while others were almost completely without such conveniences. * * *

[1] Compiled from Nebraska Sta. Bul. 119.

On the whole it may be said that these spraying demonstrations were conducted not under ideal conditions but under conditions fairly representative of eastern Nebraska orchards, and that, therefore, conclusions rightly drawn from the work should be of value to orchard owners in that part of the State. The results were not exceptionally good. In fact, the up-to-date orchardist should be able to get, and does get, better results than those reported here.

The following statements give a summary of the results obtained from the first four years' work:

COST OF SPRAYING.

Number of orchards sprayed, 16.
Total number of trees sprayed, 3,300.
Average age of trees, 18 years.
Average number of sprayings per year, 4.
Average quantity of spray per tree each year, 13 gallons.
Average quantity of spray per acre (50 trees), 650 gallons.
Average cost of spray material per 100 gallons, 87 cents.
Average cost of applying spray per 100 gallons, 98 cents.
Average total cost of spraying per 100 gallons, $1.85.
Average annual cost of spray material per tree, 11.3 cents.
Average annual cost of applying spray per tree, 12.7 cents.
Average total annual cost of spraying per tree, 24 cents.
Average total annual cost of spraying per acre (50 trees), $12.

RESULTS OF SPRAYING.

Average annual yield and net value per tree:		
Sprayed trees—		
Marketable fruit (4.4 bushels at 52 cents)	$2.28	
Culls and windfalls (1.1 bushels at 6 cents)	.07	
Total (5.5 bushels at 43 cents)		$2.35
Unsprayed trees—		
Marketable fruit (1.8 bushels at 41 cents)	0.73	
Culls and windfalls (1.7 bushels at 5 cents)	.08	
Total (3.5 bushels at 23 cents)		.81
Difference between sprayed and unsprayed trees		1.54
Average cost of spraying		.24
Average net gain from spraying		1.30
Average annual yield and net value per acre (estimated on basis of 50 trees):		
Sprayed trees—		
Marketable fruit (220 bushels)	$114.40	
Culls and windfalls (55 bushels)	3.30	
Total (275 bushels)		$117.70
Unsprayed trees—		
Marketable fruit (90 bushels)	36.90	
Culls and windfalls (85 bushels)	4.25	
Total (175 bushels)		41.15
Difference between sprayed and unsprayed trees		76.55
Average cost of spraying		12.00
Average net gain from spraying		64.55

17368°—Bull. 479—12——2

Whether it pays to spray apple orchards in eastern Nebraska is no longer a question. The records reported here—records secured under actual farm conditions—show that spraying pays twice its cost by increasing the yield of fruit and three times its cost by improving the quality of the fruit, or six times its cost by both increased yields and improved quality. The gain due to spraying one-half acre of apples one year will, on the average, buy a good barrel-pump, 50 feet of hose, 2 extension rods, 2 nozzles, and 5 barrels for use in mixing spray materials. The sprayer will last several years and can be used to fair advantage in orchards up to 5 acres. The gain from the proper spraying of 5 acres one year will, under average conditions, pay for a power outfit, including a small gasoline engine, pumps, rods, nozzles, hose, 250-gallon spray tank, elevated spray platform, and the truck on which to mount the whole outfit. One such power sprayer is ordinarily sufficient for an orchard of 20 acres and is often used in orchards of more than twice that size. The question of whether one can afford to spray has been answered. It would not be so easy to determine how anyone who owns an orchard can afford not to spray.

These results and conclusions apply specifically to eastern Nebraska, but it is believed that they are worthy of serious consideration wherever thorough spraying is not a regular orchard practice.

A NEW TYPE OF SPRAY NOZZLE.[1]

The effectiveness of spraying depends in large measure upon the character of the nozzle used, and it is especially important that the nozzle should be adapted to the specific purpose for which it is to be used. G. E. Stone, of the Massachusetts station, has devised a nozzle which he has used with very satisfactory results in spraying large trees from a high-pressure machine.

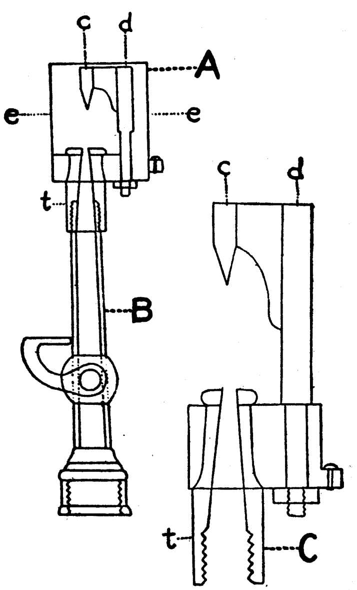

FIG. 1.—A new type of spray nozzle adapted to high-pressure work on large trees.

This nozzle is shown in figure 1, at *A*. It consists of a nozzle screwed tightly onto the tip of a standard attachment provided with shut-off, such as is often employed in spraying work. (See *B*.) The attachment, however, is incidental, as it may be fitted to any suitable metal connection threaded to fit, and provided with a hose connection at the lower end. The essential part of the nozzle, as shown at *A*, consists of a small brass tip, *t*, about $1\frac{1}{2}$ inches long, provided with an aperture at the end $\frac{1}{8}$ of an inch in diameter, although sometimes an aperture of $\frac{5}{32}$ or $\frac{3}{16}$ of an inch in diameter has been employed. About an inch or more above the center of the aperture there is placed a solid brass rod, *c*, $\frac{1}{4}$ of an inch in diameter. This is attached to another rod, *d*, by means of a thin sheet of

[1] Compiled from Massachusetts Sta. Rpt. 1910, pt. 2, p. 69.

brass; the rod *d* works in a socket and allows the pointed brass rod *c* to be thrown in or out of center at will. The object of this center brass rod, *c*, is to take the spray as it comes out of the ⅛-inch nozzle under high pressure and break it up into a fine mist, and with the pressure which we used it is capable of throwing the mist 20 or 25 feet. This is sufficient to reach, from a ladder, most of the foliage on a large elm tree. In case it is necessary to reach higher, the adjustment is thrown out of the center and the spray goes directly through the ⅛-inch aperture. By this means a greater distance and carrying power are secured, although not so fine a spray.

In the drawing the nozzle is shown surrounded by a shield, *e*, which was for the purpose of protecting the point, *c*. The nozzle as originally constructed was not provided with a shield, being used for some days without it, but with the hard usage which it received [it was] found that the adjustment was likely to be injured. The nozzle was used in connection with a machine giving 250 pounds pressure, and the spraying mixture was carried through a 1-inch hose.

This nozzle was used * * * in spraying over 1,000 trees having an average diameter of about 22 inches. Careful estimates made showed that the average amount of arsenate of lead per tree was 1.7 pounds, or about 17 gallons of arsenate of lead in solution. The cost of spraying each tree, including the labor, gasoline, and lead, was 55 cents.

The spraying was just as thorough and the cost was about one-third of that by the ordinary method, using Vermorel and other fine-mist nozzles.

PREPARATION OF CORN FOR HOGS.[1]

The question of the most economical method of feeding corn to hogs has been very carefully studied by W. J. Kennedy and E. T. Robbins, of the Iowa Experiment Station. There has been much difference of opinion on this question and the results of previous experiments have not always been consistent.

Among the farmers the time-honored way of feeding corn to hogs is to shovel it to them directly from the crib. The keen appetite shown for dry-ear corn fed in this simple manner does not indicate that hogs are especially in need of having their corn prepared for them in any way. Still, many careful, progressive feeders, men who are ever watchful for the comfort and thrift of their stock, have come to feel that the simple form in which corn is supplied by nature can be improved. The grinding and soaking of corn are thus given an influential degree of support because so many of the best pure-bred hogs in the country are fed their corn thus carefully prepared.

While previous experiments vary in their results and in their adaptability to practical conditions, there are many cases in which a distinct advantage has followed the grinding and soaking of corn for hogs. Cooking has long since been shown to be not only a waste of time and fuel, but an actual detriment to the nutritive qualities of the grain. The evidence against it is at once consistent and emphatic. The variability of results with grinding and soaking have suggested that, while there may be certain circumstances under which they may be useful, there must surely be some cases in which they are a waste of time and money, even if they do not actually decrease the feeding value of the corn for hogs.

---

[1] Compiled from Iowa Sta. Bul. 106.

In the Iowa experiments comparisons of dry-ear corn, soaked shelled corn, dry and soaked corn meal, and dry and soaked corn-and-cob meal were made on 312 hogs of all ages.

The results clearly indicate the most profitable farm practice where corn was the main part of the ration for hogs. The fastest and most profitable gains were secured by feeding dry-ear corn until the hogs were close to 200 pounds in weight. The scoop shovel was all that was needed to prepare corn for them. Then if the hogs were to be fed longer, and the weather permitted, the most profitable gains were secured by changing them to soaked shelled corn. Spring pigs to be sold the next fall and winter thus gave the best results when fed dry-ear corn until sold. Fall pigs and the spring pigs carried over to be fattened the following spring were handled most profitably by feeding dry-ear corn until the weather became mild enough for soaking corn in the following spring, and then feeding soaked shelled corn until the finish. This was especially true when the hogs were run on pasture. The old sows made faster and more economical gains on dry corn meal than on ear corn, but the benefit from this was largely lost when it was finally necessary to ship them to market on ear corn. They were handled most profitably by feeding soaked shelled corn. It should be borne in mind that corn soaked 12 hours gave better results than that soaked 24 hours. * * *

It proved useless to grind corn for hogs of any age when the weather was warm enough to permit soaking. In every case, where grinding has shown a saving of corn, simple soaking 12 hours in water has shown a still greater saving. * * *

In general, hogs that had been accustomed to corn prepared in some form received at least a temporary check in rate and economy of gains when for any reason a change was made to dry-ear corn. When the gains had been very rapid on the soaked or ground corn this effect was more marked and in some cases offset any beneficial effect of the preparation of the corn.

These experiments indicate, therefore, that grinding corn for hogs is as a rule unnecessary and unprofitable, although soaking may be of advantage under certain circumstances. The simplest and most profitable method in most cases is to feed dry ear-corn with a scoop shovel.

EXPERIMENTS IN BEEF PRODUCTION.[1]

INTRODUCTION.

The cutting up of the open ranges into farms means that in the future a large part of the beef produced in the United States will come from animals bred, fed, and finished in the same locality. Though cattle may not make as cheap gains as sheep or hogs, yet where there are large quantities of roughage at the disposal of the feeder beef can be produced on high-priced lands in the corn belt.

[1] Compiled from Alabama College Sta. Buls. 150, 151; Illinois Sta. Bul. 142; Indiana Sta. Buls. 142, 146; Michigan Sta. Bul. 261; Missouri Sta. Bul. 90; Montana Sta. Bul. 78; Nebraska Sta. Buls. 116, 117; Pennsylvania Sta. Bul. 102; Rpt. 1909, pp. 146–153; Tennessee Sta. Bul. 79; Rpt. 1908, pp. 116–118; U. S. Dept. Agr., Bur. Anim. Indus. Bul. 131; Canada Expt. Farms Rpts. 1910, pp. 75–87; Proc. Soc. Prom. Agr. Sci., 30 (1909), pp. 70–98.

Recent work at the experiment stations in Indiana and Pennsylvania show that silage is an excellent feed for steers, and where its use can be extended into the summer the land commonly devoted to pasture can be reduced in area, an important factor where farm values are high. The requisites for the economical production of beef on high-priced lands are good breeding and good feeding, and because there are no cheap pastures the animal must be pushed from calfhood to the block, although it is not always necessary to market it as baby beef. Profitable beef production in the future means that steady gains must be made. This is possible where the finishing is done on the same farm where the calf is reared. The economic loss imposed by the shrinkage from the range to the feed lot can be avoided by the feeder who also is the breeder.

It is the purpose of this article to summarize recent results obtained in feeding steers at some of the experiment stations, which may be of value to those engaged in feeding and finishing cattle and who are seeking information on this point.

STEER FEEDING AS AN AID IN MAINTAINING SOIL FERTILITY.

One advantage in feeding steers on the farm is the maintenance of the soil fertility. This has been well demonstrated in experiments at the Tennessee station to test the feeding capacity of acre plats of corn, soy beans, and cowpeas, the manure in each case being returned to the plats, and the economy of this conversion of the crops into beef as compared with direct sale of the crops. In 1906–7 an acre of corn lasted 4 steers for 54 days and produced a gain of 129 pounds; an acre of soy beans lasted a similar lot of steers 80 days and produced a gain of 406 pounds; an acre of cowpeas lasted 54 days and produced a gain of 289 pounds. In 1907–8 the gains for the corresponding lots of steers were—for the corn lot, 203 pounds; the soy bean lot, 541 pounds; and the cowpea lot, 327 pounds. The results afford an excellent illustration of the advantage of growing and feeding legumes to steers from the standpoint of maintaining the fertility of the farm. By the return of manure from the feeding of crops there was a marked increase in the productiveness of the soil, especially in the case of soy beans, with which the feeding capacity for 4 steers per acre was increased from 80 days in 1905–6 to 100 days in 1908–9. The cost of growing the soy beans in these experiments was about $13 per acre.

"BABY BEEF" EXPERIMENTS.

At the Michigan station feeding trials were made for several years to compare the relative profits of two methods of handling an ordinary grade beef herd. In one lot, which consisted of grade cows,

the calves were nursed by their dams and also received supplementary feed. After weaning, they were finished and marketed as baby beeves at 18 months of age. In another herd, consisting also of 10 grade cows, the calves were reared on skim milk and supplementary feed, and finished and marketed with the other lot, their dams being milked. The results obtained indicate that—

Baby beef production by the skim-milk method is much cheaper and gives better results than by the suckling method.

When marketed at an average age of 18 months, calves raised on skim milk weighed 966 pounds, while those that had suckled their dams weighed 995 pounds, which is not a wide difference in weight. The skim milk fed baby beeves cost $50.60 per head, while the suckled baby beeves cost $66.97 per head, a difference of $16.37 per head in favor of the former method. The skim milk baby beeves were produced for $5.23 per hundredweight as compared to a cost of $6.73 per hundredweight for the others, a difference in economy of production of $1.50 per hundredweight in favor of the skim milk fed animals. * * *

The quality of the baby beeves produced by the two methods was practically the same and the skim milk lots brought the same prices as the suckled lots when put on the market. As noted before, the cost of production is undoubtedly higher than it would be under ordinary farm conditions, but nevertheless the figures as given show the comparative costs and values correctly and conclusions as to the methods of feeding may be safely drawn.

In a baby-beef experiment at the Canada experimental farms, 5 steers weighing 504 pounds each on a limited growing ration, in which the grain consisted of bran, gluten, oil meal, and corn, made in 393 days an average daily gain of 1.23 pounds per head at a cost of 5.5 cents per pound. In this case there was a loss of $2.04 per head. On the other hand, 6 steers weighing 593.3 pounds each, on a full fattening ration for 290 days, made an average daily gain of 1.61 pounds per head at a cost of 6.02 cents per pound. The average profit per head in this case was $5.19. Five calves dropped in 1907, weighing at the start about 84 pounds each, fed a limited growing ration, of which the grain consisted of bran, oil and gluten meals, oats, and corn, made an average daily gain for 729 days of 1.24 pounds per head at a cost of 4.66 cents per pound. There was an average loss per steer of $2.05. Six steers weighing 106 pounds each, on a full fattening ration containing the same ingredients, made an average daily gain in 626 days of 1.52 pounds per head at a cost of 4.88 cents per pound. The profit per head was $5.19.

In another experiment 4 yearlings, averaging 472.5 pounds in weight, fed for 190 days on a ration of clover hay, silage, roots, straw, bran, and gluten, made an average daily gain of 2.17 pounds per head at a cost of 5.73 cents per pound. The net profit per steer was $4.43. Nine steers, averaging 1,145 pounds in weight, fed for 100 days on the same ration with oil meal in addition, made an average daily gain of 2.77 pounds per head at a cost of 5.61 cents per

pound. Three steers weighing 923 pounds each, on a grain ration of bran and ground corn for 70 days, made an average daily gain per head of 2 pounds at a cost of 8.15 cents per pound. The net profit per steer was $1.47. Three steers weighing 735 pounds each, on a grain ration of bran and oil meal for 70 days, made an average daily gain of 2.1 pounds per head at a cost of 7.19 cents per pound, and gave a profit per head of $1.26. Three steers weighing 837 pounds each, on a grain ration of bran, gluten, and oil meal for 70 days, made an average daily gain of 1.53 pounds per head at a cost of 9.9 cents per pound. There was a net loss of 12 cents per steer.

INFLUENCE OF AGE AND CONDITION OF THE ANIMAL.

J. H. Skinner and W. A. Cochel carried on a 3-year experiment with calves, yearlings, and 2-year-olds at the Indiana station to study the influence of age on the economy and profit of feeding for beef production. The results indicated that the intial cost per hundred pounds of meat produced was greater with the calves than with the older cattle; that the length of time necessary for finishing steers decreased with age; that the rate and the cost of gain and the proportion of roughage to concentrates consumed increased with age; and that the amount of gain necessary in finishing cattle of equal condition decreased as their age increased. The difference in total quantity of feed necessary for finishing cattle of different ages and fed to the same marketable finish was negligible.

The average margin required between buying and selling prices to prevent loss was $1.60 per hundred on calves, $1.71 on yearlings, and $1.55 on 2-year-olds; the margins secured on a stationary market were $2.02 on calves, $2.22 on yearlings, and $2.09 on 2-year-olds, resulting in a profit of 42 cents per hundred on calves, 51 cents on yearlings, and 54 cents on 2-year-olds.

The increase in live weight necessary to make calves prime was 103 per cent, yearlings, 54 per cent, and 2-year-olds, 43.6 per cent of their initial weights at the beginning of the feeding period.

At a uniform price for feeds the difference in cost of gains between calves and yearlings was $1.35, between yearlings and 2-year-olds, 28 cents per hundred pounds.

The experienced farmer who feeds cattle should handle older cattle in preference to calves, while the farmer who produces and finishes his own cattle may find calves more preferable.

EFFICIENCY OF DIFFERENT TYPES OF STEERS.

H. P. Armsby, of the Pennsylvania station, in cooperation with this department, compared the beef type with the scrub as a meat producer. A pure-bred Aberdeen-Angus steer 8½ months of age, and a steer 11 months old, of the dairy type, containing a large percentage of Jersey blood, were under observation over 2½ years. Both animals received similar rations, which consisted of hay, bran, and

mixed grains. The live weight was frequently taken, and the digestibility of the total ration and the nitrogen balance were determined at intervals. The growth of the pure-bred steer was more largely in body girth, while the scrub steer increased relatively more rapidly in length and height, or, in other words, the pure-bred steer showed a tendency to fatten, while the scrub inclined to gain relatively more nitrogenous material. It is thought that the difference in temperament explained in large part the economic superiority of the beef type, for apparently "the two steers did not materially differ as regards digestive power, percentage of feed energy metabolized, or percentage availability of the feed energy."

The pure-bred steer was superior to the scrub in that his maintenance requirement was less while his capacity to consume feed was greater. On the moderate rations fed, he manifested this superiority, however, not in the form of greater gain of live weight from a unit of food, but in the production of higher quality of product, representing the storage of more energy available as human food.

From a study of individuality H. R. Smith, of the Nebraska station, concludes that—

Nearly all of the largest gainers * * * were steers which measured large middle girths at the beginning of the feeding period, and it would seem that size of middle girth is an important factor in determining future gains. In these experiments the size of bone did not seem to bear any definite relationship to rate of gain, some of the best gainers being large in bone and some relatively small; nor was there any definite relationship between heart girths and rate of gain, though the large majority of the best doers of the several groups were large in heart girth. With but few exceptions the best gainers showed more pliability and softness of skin.

USE OF A SELF-FEEDER FOR SHORT-FED STEERS.

The Illinois station reports a test of a self-feeder for short-fed steers. In general the financial results of the test were favorable for the self-feeder, and while the data are not extensive they indicate that for short feeding cattle the plan of chaffing hay, mingling it with grain, and feeding it through a self-feeder is worthy of a further investigation and trial by feeders.

SUPPLEMENTS TO PASTURE IN MISSOURI.

After five years' work in fattening cattle on pasture and supplemental feeds at the Missouri station, F. W. Mumford finds that in general the grains were more uniform and a better finish was obtained when corn was supplemented with other grain. The fatter the animal the more efficient the supplemental rations, and, hence, it was profitable to feed a limited amount of supplements containing a large percentage of protein, such as linseed meal or cottonseed

meal, during the later stages of the feeding period. Although the young cattle made faster gains with nitrogenous supplements the increase was not sufficient in most cases to make it profitable.

BULKY VERSUS CONCENTRATED RATIONS.

In experiments at the Pennsylvania Experiment Station it was found that when corn was high in price it was more profitable to feed a lighter grain ration with a greater proportion of roughage, or, when a heavy grain ration was fed, to market the cattle before they became as fat as those fed heavily on grain at the close of the experiment. As in the two preceding winters, the chief demand in Pennsylvania was for cattle not made fat enough to grade as "choice" or "prime" upon the central markets, but for those that grade as "good butcher" steers or "good killers." A study of the consecutive months during the test indicated that with thin cattle a bulky ration was as efficient as one of more concentrated form, but as cattle fatten concentrates become necessary if the rate of gain is to be maintained. When corn silage was substituted for part of the ear corn the effect was to reduce the cost of production and to increase the rate of gain.

In experiments at the Nebraska station to determine the most economical proportion of corn and alfalfa, it was found that on a heavy feed of corn, and of alfalfa hay and corn stover in equal parts as a roughage, the average daily gain per head was 2.42 pounds at a cost of 6.78 cents per pound. Corresponding figures on a light feed of corn, and with alfalfa and stover in the proportions of 6:4, were 2.01 pounds at a cost of 6.51 cents. On a heavy feed of corn, and with alfalfa and stover 4.5:5.5, the gain was 2.55 pounds at a cost of 8.77 cents per pound. On a medium feed of corn, with alfalfa and stover 5.5:4.5, the gain was 2.34 pounds at a cost of 8.76 cents per pound. On a light feed of corn, with alfalfa and stover 6:4, the gain was 2.08 pounds at a cost of 8.03 cents per pound. On a heavy corn ration, with alfalfa as the only roughage, the gain was 2.73 pounds at a cost of 8.62 cents per pound, on a medium corn ration and alfalfa 2.86 pounds at a cost of 7.76 cents per pound, and on a light corn and alfalfa ration 2.71 pounds at a cost of 6.95 cents per pound. The groups fed the medium and heavy grain rations dressed practically the same, with a slight difference in favor of the medium group. Those fed the light grain ration dressed somewhat light because of their lower condition.

These experiments were made in different years and the price of feeds varied somewhat, but from the entire series it is concluded "that with corn above 35 cents per bushel and with alfalfa not to exceed $7 per ton, the old method of fattening cattle for market,

namely, that of crowding with grain and using but little roughage, is much less profitable than a more moderate use of grain and correspondingly more roughage. Not to exceed three-fourths of a full feed of corn and a correspondingly larger quantity of alfalfa will give practically the same daily gains."

A TEST OF HAYS FOR WINTER FEEDING.

At the North Platte substation in western Nebraska a continuous record was kept of a mixed lot of good grade steers, which were kept in a common pasture in summer and fed different rations in winter, from December 3, 1907, to August 5, 1910. The hays tested were alfalfa, prairie, and cane. It was found that steers which went on grass in the spring thin in flesh increased in weight faster during the summer than the steers which went on grass in good flesh. The steers wintered on alfalfa or a ration of one-half alfalfa made faster gains during the winter than those wintered on prairie hay or cane alone, but did not make as fast gains the following summer. Steers wintered on a ration of alfalfa or one-half alfalfa made a greater gain during the winter and the summer following combined than steers wintered on prairie hay or cane alone. Both yearling and 2-year-old steers lost weight when fed cane or a ration of one-half cane and one-half prairie hay, whereas steers fed alfalfa or a ration of one-half alfalfa gained in weight each winter. The value of alfalfa in comparison with prairie hay or cane was higher when fed to cattle that were sold in the spring than when fed to cattle sold in the fall. At the price of feeds estimated (alfalfa $6, prairie hay $5, and corn hay $4 per ton, corn 50 cents, and oats 35 cents per bushel), it was not profitable to produce steers for the feed lot.

COST OF BEEF PRODUCTION IN THE SOUTH.

The Alabama College station, in cooperation with this department, has completed a series of experiments to determine the cost of raising a grade steer to the feed-lot period under southern conditions. The steers used were grade Angus. During the summer months no feed was given in addition to the pasture, which consisted principally of white clover, Bermuda, and Lespedeza. In addition to the winter range, hay and cottonseed were fed, the hay consisting of a mixture of sorghum, crab grass, Johnson grass, and cowpeas, and was not of good quality. For the entire year the calves made a daily gain of 0.77 pound, or a total gain of 276 pounds per head. The yearlings made a daily gain of 0.564 pound per head, or a total gain of 203 pounds for the 12 months. The cost per hundredweight of raising a steer when the manure received no credit was estimated as follows: To 12 months of age, $5.07; to 24 months of age, $4.84; to 30 months

of age, $4.95; and to 33 months of age, $4.90. It is stated that these gains could have been made more cheaply if the cattle had been free from ticks, and a combination of clover and Bermuda pasture had been used to lengthen the pasture season.[1]

A FEEDING TEST IN THE NORTHWEST.

A five-year test in feeding steers at the Montana station showed a small profit except in one season. The principal feeds used were clover hay and a grain mixture of barley, oats, and wheat. With well-cured clover hay the cost of gain was about one-half of that obtained with poorly cured hay if both hays were estimated at the same price. The most economical grain ration ranged from 3 to 7 pounds, according to the quality of the hay.

PREPARATION OF CHOICE HAMS.[2]

CURING.

Home curing of hams is probably not as general as it was in former years. Still it would seem that no farmer who raises hogs should be without the knowledge required to prepare hams of good quality at least for home use. The process is comparatively simple and requires no special skill. As pointed out by E. W. Magruder, of the Virginia State department of agriculture, the essential conditions which must be realized are healthy hogs and sound meat.

To secure the healthy hogs, give them plenty of range with as great a variety of food as possible, and plenty of good, clean water. Smithfield hogs are allowed to run at large most of the year. If you have woods to supplement your pasture, so much the better. The hogs then obtain a variety of food, as nuts, berries, roots, and grass. In hunting over the large range they take sufficient exercise to keep them healthy and develop and enlarge the muscular tissues, that is, the lean meat, but as the work is not hard, the muscles grow without becoming tough and stringy. Allow them a good range up to the time of killing, and do not fatten them in pens. They fatten as well when left out in the fields and keep healthy. As they fatten they travel less, but this travel converts much of the food into muscle or lean meat instead of altogether into fat, as is the tendency when penned, as illustrated by the western meat. To have the best meat and that which brings the best price and which has the best flavor, and with the fat and lean properly intermixed and proportioned, you must let the hogs have plenty of exercise and then kill them before they are too fat. Have them fat, but not so fat they can hardly walk. There is no economy in having them too fat, and the meat is not so good.

To secure sound meat "be careful to kill only in cold, frosty weather. After November 1 is safest. Allow to hang up all night

[1] For previous articles on steer feeding in the South see U. S. Dept. Agr., Farmers' Buls. 124, p. 27; 259, p. 27; 412, p. 16.

[2] Compiled from Louisiana Stas. Bul. 124, p. 56; Rpt. State Bd. Agr. Virginia, 1900, p. 114; U. S. Dept. Agr., Bur. Anim. Indus. Rpts. 1895–96, p. 97.

to drain and thoroughly cool. The hog cuts out nicer and keeps better if stiff when cut out."

There are various excellent ways of curing the hams. The following, used for many years with success on the farm of Col. Chas. Schuler, commissioner of agriculture of Louisiana, is described in a bulletin of the Louisiana station:

When hogs are fat, select any time during the month of December, January, or first half of February, when weather is clear, wind from the north to northwest, with the thermometer registering below 35° F. at sunrise. Have your water hot and scald as soon as hog is dead. Hang up and disembowel the animal just as soon as it is cleaned. No butchering animal should ever be permitted to cool off until after it is disemboweled. Cut up the carcass as soon as it is through dripping. Saw or split the backbone. Let it and the spare rib remain on the side, and make them as long as you can. Hams and shoulders small. Hams to sell readily should weigh from 15 to 18 pounds. * * *

To half bushel fine salt add half pound pulverized saltpeter, 1 pound finely ground black pepper, 4 pounds brown sugar; mix thoroughy. Rub ham with mixture. Pack in box, skin side down. Apply double handful of mixture to flesh part of each ham. Then apply plenty of clean salt, never permitting the meat to touch, without salt being between, covering all parts and filling every crevice, and let them remain in the salt six weeks.

After being in salt six weeks, select a clear day, string each ham, and dip in a boiling solution of 1 pound borax dissolved in 15 gallons of water and hang up high in a dark smokehouse (the higher the better) and smoke, using green hickory wood. Smoke daily for two weeks or more, as preferred. By April 1 at latest, hams should again be dipped in boiling water, to cleanse them from all impurities, wrapped in paper, then cloth, and this painted with some cheap mineral paint. Hang up again and leave until used or sold.

Two methods which have been successfully used by Virginia farmers are described by Dr. Magruder as follows:

(1) On the fleshy surface of each ham rub in thoroughly fine saltpeter; use one tablespoonful to a 15-pound ham, and vary the amount according to size of ham. Then pack away for 4 to 6 hours, with flesh side up, in order to give the saltpeter time to strike in; then take up and rub well with salt and pack away, using plenty of salt. As they are packed away they should be pressed into plump, symmetrical shape while soft. Pack near top of bulk, and never over 2½ or 3 feet deep. If they are packed deep and have other meat put on top of them, they will be mashed flat and out of shape. They remain packed in plenty of salt for 6 weeks, when they are taken up, well washed, and when nearly dry about one teaspoonful of powdered borax is sprinkled over the fleshy surface from a large pepperbox. The borax is to keep off skippers. They are then hung up by the hock and smoked lightly on damp days with hickory chips. When about 9 months old they are sold. The hogs average about 180 pounds, making hams from 10 to 18 pounds. * * *

(2) Salt lightly one or two days to bring out blood; then to each 100 pounds of hams use 8 to 10 pounds of salt, 2 ounces saltpeter, 2 pounds brown sugar, and 1 ounce of red pepper; add to 4 or 5 gallons of water in a tub and thoroughly mix. This brine should be strong enough to float a fresh egg. Place hams in a tight barrel and pour brine mixture on till hams are all covered.

After remaining in brine 4 to 6 weeks, hang up by hock and smoke gently several weeks with hickory chips. Early in March, before warm days, when flies begin to move, wrap each ham in paper and put in a bag and rehang. By late summer the hams are ready for market.

The method of preparing the famous Smithfield hams of Virginia is fully described in a report of the Bureau of Animal Industry of this department. The method of curing is there described substantially as follows:

The flesh surface is sprinkled with fine saltpeter until the hams are as white as though covered by a moderate frost; or, say, use 3 or 4 pounds of saltpeter to 1,000 pounds of hams. Immediately salt with fine Liverpool salt, covering the entire surface. Pack the hams in bulk, not deeper than 3 feet. In ordinary weather they should remain thus for 3 days. Then break bulk and resalt with the fine salt and again pack in bulk, and each ham should remain in bulk one day for each pound the ham weighs; that is, a 10-pound ham should remain 10 days. The hams are then taken up and thoroughly cleaned by washing in warm water. When nearly dry rub the entire surface with fine black pepper. The hams should now be hung up and gradually and slowly smoked for 30 or 40 days with hickory or red oak. When the smoking is completed they should be repeppered and bagged to guard against vermin.

It is stated that "these hams improve with age, and may be considered perfect when one year old."

Commenting upon methods of curing hams, Dr. Magruder says:

The saltpeter is used to give the ham a good, red color, to make it firm, and also as a preservative. The salt, of course, is used as a preservative, and plenty of it should be used, as the excess will not hurt, and not enough will allow the meat to spoil. When packing in bulk, be sure to press the hams into a plump, symmetrical shape, and do not have the bulk over 3 feet high, otherwise the weight will flatten out the lower hams and spoil their shape. The plumpest Berkshire ham can be spoiled in shape by improper packing. Pepper and sugar are added, presumably to improve their flavor, but I have never seen that they improve them any, and I advise against sugar or molasses, as it is more trouble and attracts flies. The pepper may be used if desired, as it will do no harm and may help to keep off skippers. The borax is added to keep off flies, which lay the eggs, which hatch into skippers, and if properly applied is a sure preventive. Bagging is for the same purpose, but unless done early and thoroughly before the flies come about it is ineffective. It is troublesome. The smoking, which should be done in damp weather, is supposed to serve several purposes. First, to dry the meat and thus make it keep better; second, to deposit a little creosote and other ingredients from the burning wood on the bacon, which improves its keeping qualities, and also supposedly improves its flavor. In my opinion, the object in curing should be to preserve the ham, keep it sound, and then let it retain all of its natural taste and flavor and not try to add flavor and taste. The natural ones, when preserved in their purity, are good enough without trying to add to them artificially.

In hanging meat care should be taken not to allow any two pieces to touch, for if so they are liable to be infested with skippers. Hams should not be eaten until at least six months old. When two years old they have reached their prime. Many claim they still continue to improve for many years, but I very much doubt it.

COOKING.

As Dr. Magruder states, "after the ham is cured one of the most important operations must be gone through with before it is ready for the table—that is, the cooking."

The hog may have been raised right, fattened properly, killed at the right time, and cured as it should be, but if it is not cooked properly the previous work is all in vain and the ham is not good. * * * A large ham—say 18 pounds—is much better flavored, sweeter, and more juicy than a small one—say under 8 pounds.

Wash the ham thoroughly, then soak in cold water several hours, the time varying with the size of the ham. This soaking is to dissolve out the excess of salt. The ham is then put in the boiler full of boiling water. The temperature should then be lowered slightly and the boiler just kept simmering. Keep the water just barely boiling for 4½ hours for an 18-pound ham; that is, a quarter of an hour for each pound of ham. If the hams are larger or smaller, vary the time to suit the weight. As the water boils out, add fresh boiling water, and always keep the boiler full. For very large hams it is advisable to cook in two waters. Why should the ham be put in boiling water? Portions of the lean meat, the albumin, and some of the juices and flavors are soluble in warm water, while boiling water coagulates the albumin just as it does the white of an egg. So, if put in cold water and heated to the boiling point, some albumin and much of the delicate flavors which are so sought after in hams would be dissolved out by the water as it warmed up to the boiling point; but if put into boiling water, the albumin is coagulated at once on the surface and all the juices and flavors sealed in and kept there till eaten. While cooking the ham is just kept at the boiling point of water, which is sufficient heat to cook it thoroughly without separating the fibers or "boiling it to pieces," as a rapid or hard boiling would do.

The subject of the cooking of meats is more fully discussed in U. S. Dept. Agr., Farmers' Bulletins 34 and 391.

FACTORS AFFECTING THE PERCENTAGE OF FAT IN CREAM.[1]

One of the constant sources of friction between creameries and their patrons is the variations in the richness of cream. In order to arrive at a better knowledge of the factors affecting the percentage of fat in cream, experiments were conducted by O. F. Hunziker, of the Indiana station, and C. H. Eckles and H. S. Wayman, of the Missouri station.

In testing the effect of speed with five different makes of hand separators on richness of cream, the Missouri station found that with one exception, set for thin cream, the greater the speed of the machine the higher the percentage of fat in the cream, and this effect was much more marked when the cream screw was set for thick cream. Within ordinary limits the greater the speed the less the amount of fat remaining in the skim milk. This did not vary to any marked extent whether the separator was set for thin or thick

[1] Compiled from Indiana Sta. Bul. 150; Missouri Sta. Bul. 94.

cream. The rate of inflow was uniformly increased by the speed. The explanation given for this is not that the greater the speed of the separator the more milk will run through it in a given time, but that it is due to suction caused by the flow of air through the machine. The capacity of the separators did not vary to any extent whether set for thick or thin cream. By varying the speed of the separator the Indiana station found the cream to vary in fat content from 10 to 65.5 per cent. The work of both stations proved that, contrary to the general assumption, the higher the temperature of the milk separated the thinner the cream. This was found to be more marked when the separator was set for thick cream than for thin cream. The colder the milk separated the greater the loss of fat in the skim milk. That the percentage of fat in the cream varies practically in direct proportion with the percentage of fat in the milk separated, or, in other words, that the ratio of cream to skim milk is not changed by the variation in the richness of the milk separated, was demonstrated by both stations. Prof. Hunziker found that by varying the rate of inflow the precentage of fat in cream varied from 23.5 to 70, the greater the rate of inflow the thinner the cream. This was substantiated by Profs. Eckles and Wayman, who found that even the height of milk in the feed can affected the fat content of the cream to some extent. Acidity had but little effect according to the Missouri station, except that with sour milk there is a tendency for the percentage of fat in the cream to be increased, especially when the cream screw is set for thick cream. A small obstruction in the skim-milk tube, due to dirt or some other foreign substance, does not as a rule make any marked change in the operation of the machine. If the cream opening is partly closed, however, the cream becomes smaller in quantity and richer. The accumulation of separator slime sometimes results in a larger quantity and thinner cream due to a partial obstruction of the skim-milk tube. To show definitely the effect of the amount of water used to flush the bowl on the richness of cream, Prof. Hunziker conducted experiments with the following results. When no water was used the average percentage of fat in the cream was 37.8; with water equal in amount to the capacity of the bowl, 37.3; with sufficient water to cause the cream discharged to appear watery, 35; and when twice the amount of water needed was used the percentage of fat in the cream was 33.5.

These experiments prove conclusively that, even though there is a wide variation from day to day in the cream tests, it does not necessarily follow that the creamery is dealing dishonestly with its patrons. They also show the necessity for uniformity in the care of milk on the farm, especially as regards separation, and in the sampling and testing of cream at the creameries.

If cream is tested correctly and if the tests of different lots of cream from the same patron vary, then these variations must be due to variations in the richness of the cream. It is impossible to procure cream of exactly the same richness from different skimmings from the gravity can. The richness of cream from a farm separator is primarily determined and regulated by the cream screw. The richer the milk the richer the cream if all conditions remain the same, for the ratio of skim milk to cream remains constant. During early summer months the milk is usually comparatively low in fat. Advance in lactation period and change from succulent to dry feed cause milk to become richer in fat. The first drawn milk is much poorer in fat than the strippings. The greater the amount of milk running into a separator of a definite capacity per hour the thinner will be the cream. The greater the speed of the separator the richer the cream. If the speed is too low a large amount of the fat is lost in the skim milk. Warm milk produces more and thinner cream than cold milk. The proper temperature to separate milk on the farm is from 90 to 95° F. and immediately after it is drawn. The more water or skim milk used to flush the bowl of the separator the thinner will be the cream. The most satisfactory cream for the creamery is that which tests about 35 to 40 per cent fat.

If the tests are to be uniform and accurate, the cream must be in such condition, when sampled, that a fair and representative sample can be taken. If, at the time of sampling, the cream is too thick, is tough, dry and leathery on the surface, is partly churned or curdy, it is very difficult to secure a fair sample, and tests of such cream are likely to be irregular as well as inaccurate.

In order that the cream may be in proper condition for sampling and testing upon delivery to creamery, the farm separator should be thoroughly cleaned and scalded after each separation; after separation, the cream should be immediately cooled and kept cool by setting in cold water; the cream should be stirred occasionally; the cream should be delivered in clean cans not less than twice per week in winter and three times per week in summer; in transit the cans should be covered with a dry blanket or jacket in winter, and with a wet blanket or jacket in summer; cans should be reasonably full of cream in transit to prevent churning.

[A list giving the titles of all Farmers' Bulletins available for distribution will be sent free upon application to a Member of Congress or the Secretary of Agriculture.]